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A THEORY OF PROFIT AND INTEREST

SUMMARY

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INTRODUCTION

THE laws to be established here are as follows: In every business there is a size of capital, called optimum size, which yields a maximum rate of profit. The rate of profit on other capitals exhibit a law of increasing returns below, and one of decreasing rates beyond, the optimum size. The cost of production decreases with the increase of capital even beyond the optimum size. The rate of interest on loans has a minimum in every industry, namely, in the loan to the optimum size of the industry. The interest paid by the borrower to the lender cost the borrower nothing, neither labor nor time; because it is created by the law of increasing return, without additional labor, without additional time.

In what follows, the term capital is used as equivalent to "total investment," and in the case of corporations it includes the following items:[1] "Capital stock, bonds, and other long-term debts; surplus as reported by the company; all items of appropriated surplus, such as reserves for income and excess profits taxes, discounts, bad debts, etc.; and the average of current borrowings as shown for the first day of each month. Reserves which were not appropriations of surplus, such as depreciation on buildings, machinery, etc., were not included. From the sum of the foregoing items were deducted such assets as are attributed to good will, patent rights, trade marks, etc., together with the sum of all investments in property not used in the manufacture."

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[1] Federal Trade Commission Report on Shoe and Leather Costs and Prices, June 10, 1921, p. 97.

The most closely guarded secrets of every business are its capitalization, its profits, and its cost of production. Our knowledge of the first was notoriously defective. This prevented the U. S. Census from ascertaining statistics on profits. It says on this point:[2] "Even if the amount of profit could be determined by deducting the expenses from the values of the products, the *rate* of profit on the investment could not properly be calculated because of the very defective character of the returns regarding capital." As to costs of production, practically no data were available, and the economists believed that in every industry they were practically the same for all factories except for differences due to different managerial efficiencies. But in 1914 the Federal Trade Commission was established and given inquisitorial powers. Its statements regarding industries are authoritative. Similarly, the U. S. Department of Agriculture has published in the last few years many bulletins on farming as a business.[3] These two series of publications furnish a fund of information to test economic doctrines.

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2. Abstract of the 13th Census of the United States for 1910, p. 437.

3. The Reports of the Federal Trade Commission will be referred to here, as "Reports" and the Bulletins of the Department of Agriculture as "Bulletins." The predecessor of the Federal Trade Commission, the Bureau of Corporations, has published, in 1911 to 1913, a report on steel, in three parts; which will be also freely drawn upon and referred to here, as Steel Report.

I. THE FACTS

1. What do we understand by the term "facts"; particularly, what are scientific facts?

If a physicist investigates the fall of a stone in space, he will use the best instruments, and among others the best clock that he can secure; and measure the fall of the stone, say for every one-tenth of a second. His measurements are facts; we shall call them the primary data.[4] If the physicist, or any other physicist, repeats the experiment the next day he will not get the same results, not the same primary data. There are three main causes for this disappointing state of affairs.[5] The physicist is not absolutely exact himself; his instruments are not accurate; and the surrounding conditions, like the weather, even the building in which the experiments are conducted are sources of error and disagreements. However often the experiment is repeated, no two results ever agree; therefore, primary data cannot possibly be used as building stones for the science. The necessity arises of devising a method by which other data, called secondary data, are derived from them; which may be used as the basis of a science. A common device is to take the measurements referring to a certain quantity and take an average of them. The figure so obtained is a secondary datum. Secondary data are those which are gotten by adjusting in any manner the primary data. They are removed one or more steps from the form in which they were observed. Every law of every science holds always good only for the secondary data, but is not necessarily true for the primary data.

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[4] H. Secrist, Statistical Methods, p. 16.

[5] L. Kotany, "The Accuracy of Labor," Quarterly Journal of Economics, August, 1920.

In trying to proceed in the investigation along the lines of the exact sciences we must try to get, for every quantity we desire to establish, as many primary data as possible; because the greater the number of primary data is, the greater the accuracy of secondary datum derived from them — and here we encounter a difficulty. Suppose we desire to ascertain the rate of profit in the shoe business, of factories with the capital of $200,000. Referring to the definition of capital given above, it is obvious that we cannot expect to find even a single factory whose capital is exactly $200,000. In order to overcome the difficulty we shall take all factories, the capitals of which are within certain limits, for instance, factories, the capitals of which are within $100,000 and $250,000, and average the rates of profits made by these factories. This is, indeed, the manner in which the statements in the Reports, and in the Bulletins are gotten up.

We now proceed to give the facts as ascertained in the Reports and Bulletins.

2. The Federal Trade Commission investigated the rates of profit of 237 shoe manufacturing companies, and reported as follows: [6]

Groups	Per cent earned					
	1914	1915	1916	1917	1918	1919
Under $100,000	12.8	14.6	31.5	26.5	20.6	39.9
$100,000 to 250,000	16.7	15.8	25.2	22.5	21.8	40.7
$250,000 to $1,000,000	15.5	15.2	26.6	25.0	18.2	40.8
$1,000,000 to $3,000,000	15.0	15.5	26.3	20.3	23.0	41.6
Over $3,000,000	14.7	14.6	25.4	26.3	21.3	39.9

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6. Report on Leather and Shoe Industries, August 21, 1919, p. 104. The last two years are from Report, June 10, 1921, p. 105.

In the year 1914 the capital between $100,000 and $250,000 made the maximum rate of return, and therefore this size is the optimum size. The capitals less than that exhibit a law of increasing returns, while the capitals greater than that show a law of decreasing returns. In the year 1915 the same three phenomena are shown, with one small difference pertaining to the capitals between $1,000,000 and $3,000,000. The small difference would have disappeared if the capitals had been grouped differently. For our purpose it is not necessary to have the same groups every year, they are only made if the results of one year are to be compared with the results of another year; but for the purpose of establishing economic laws each year may be considered by itself, and the fact that by a grouping of the capitals the three phenomena emerge is the important feature, and not the sizes of the groups themselves. It is also clear that the European purchases introduced the element of imperfect competition, which accounts for the deviations from these three phenomena. In the year 1916 the second item disturbs the emergence of the three phenomena, but a regrouping would show them in utmost purity. When we entered the war in 1917 the disturbance was still greater, and similarly in 1918. After the war ended in 1918, the three phenomena appear again in utmost purity in the year 1919. In that year the optimum size appears, however, for the capital of $1,000,000 to $3,000,000.

It is really only necessary to show that the maximum exists. The two other phenomena, that of increasing and decreasing rates of return, follow from it necessarily as mathematics proves.

The results in the case of fifty tanning companies are as follows:[7]

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[7] Report on Leather and Shoe Industries, August 21, 1919, p. 28.

Groups	Per cent earned			
	1914	1915	1916	1917
I. Under $100,000	9.7	15.7	24.0	32.6
II. $100,000 to $250,000	13.6	23.5	26.6	34.4
III. $250,000 to $1,000,000	12.4	16.0	30.4	29.3
IV. Over $1,000,000	12.8	16.4	34.6	25.4

Every year of the four years shows clearly the law of the maximum rate of return. The laws of diminishing and increasing returns show strictly in 1917. In 1914 and 1915, the results deviate from them in one item each by less than one-half a per cent, which is really remarkable, considering the disturbed times. In the year 1916, the divergence is greater in one item, but a regrouping would smooth this out. The fact that such a grouping according to size is possible is the essential point, the details of the grouping are of no importance.

In the commercial wheat flour milling business, the result is as follows: [8]

Groups	Per cent
I. Over 1,000,000 barrels	22.2
II. 300,000 to 700,000 barrels	23.3
III. Under 300,000 barrels	19.8

All three laws show clearly and strictly.

In the meat packing industry there are over a hundred packers with comparatively small capitals. The maximum rate of return is secured by those having a turnover of between $10,000,000 to $25,000,000. Those having larger turnovers realize a smaller return, and the five huge packers of the country have a still smaller rate of return. This appears from the following two tables: [9]

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[8] Report on Commercial Wheat Flour Milling, September 15, 1920, p. 104.

[9] Report on Meat Packing Industry, Summary and Pt. 1, pp. 91, 92 and p. 74, also Pt. 5, p. 86.

Group		Per cent
I.	Over 25 millions	19.3
II.	10 millions and less than 25 millions	23.6
III.	5 millions and less than 10 millions	13.7
IV.	2 millions and less than 5 millions	15.9
V.	Under 2 millions	12.1
I and II combined		20.6
III, IV, and V combined		14.1

The law of decreasing return is also shown, except for the discrepancy in Group III, which the regrouping would eliminate, as appears from the second part of the table.

In the meat packing business there are five great packers with huge capitals. The independent packers have very much smaller capitals, nevertheless, the rates of return secured by the latter are greater than those secured by the great packers, showing that their capitals are beyond the optimum size. This appears from the following table:

Year	Per cent earned	
	Independent packers	Five great packers
1914	12.6	8.3
1915	13.1	12.8
1916	22.1	18.5
1917	18.1	15.0

The Summary of the Report on milk and milk products, states:[1]

> The most profitable canned milk companies appear to be those having a medium volume of sales. Those companies whose sales ranged from $1,000,000 to $5,000,000 earned a rate throughout the five-year period considerably higher than that earned by companies having smaller sales. Companies having sales above $5,000,000

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[1] Summary on Milk and Milk Products, 1914–18, June 6, 1921, p. 12.

> ranked second in rate of return on gross investment, companies having sales from $250,000 to $1,000,000 ranked third, and companies having sales below $250,000 ranked fourth.

Here all three laws appear quite pure.

The manufacture of farm implements presented many difficulties, but the existence of the law of the maximum rate of return was clearly shown:[2] "In respect to the implement business, excepting the years 1913 and 1914, the smallest companies (not exceeding $1,000,000 investment) generally made a higher rate of return on investment than the larger companies and also their rate of return generally exceeded that of the International Harvester Company."

In the beet sugar industry,[3] many causes prevented the commission from making a statement in figures; but it says that there was no doubt in the opinion of those most conversant with the industry that there was an optimum size, but there was some difference of opinion as to how large the capital of such an optimum size was. In the opinion of one expert who is quoted at length, it is mentioned that the optimum size was quite small. This expert considered the plant of 450 tons capacity as the best size.

A very similar condition is shown to exist in the manufacture of canned foods.[4]

As for the steel business: "Some of the most successful concerns in the steel industry outside of the U. S. Steel Corporation, show higher rates of return upon their total investments."[5] The rate of return in the case of the latter averaged only 12 per cent for the first ten years of its existence, even on the low basis of property valuations of the Commissioner of Corporations.[6]

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[2] Report on The Causes of High Prices of Farm Implements, May 4, 1920, p. 109.

[3] Report on Beet Sugar Industries in the United States, May 24, 1917, p. 177.

[4] Report, May 15, 1921, pp. 1, 2.

[5] Report of the Commissioner of Corporations, p. 343 of Pt. 1.

[6] Ibid., p. 342.

The same results were obtained by the Federal Trade Commission when it investigated the rates of return for the War Industries Board. While the detailed statements have not yet been published, the essential feature is known, namely, that the "independents made as large or larger rates of return as the Steel Corporation." [7]

3. The three laws hold in agriculture; moreover, the knowledge that they do has been possessed by practical farmers all over the world for thousands of years.[8] "When the conditions affecting the agriculture of a region have remained stable for a considerable period local agricultural practice tends to become approximately what it should be for the best results." [9] Therefore, examples for the law of increasing rate of return can be had in abundance. Examples for the law of decreasing returns cannot be had so easily for the reason stated above. But in Bulletin No. 341, page 66, there is a table which shows clearly all three laws.

INCOME ON CAPITAL ON 378 OWNER FARMS, CHESTER COUNTY, PA.

Area groups, acres	13–40	41–60	61–80	81–100	101–120	121–160	Over 160
Per cent income	10.4	13.5	13.2	12.7	12.5	12.6	11.8

The maximum rate of return is realized on a farm from between 41–60 acres. The two other laws are shown here with almost ideal purity. The general remarks of the authors on the subject of this paper are so lucid, so happily expressed, that they may well be quoted.[1]

> As will be seen in what follows, there appears to be under given conditions, a most profitable magnitude for many of the enterprises of these farms. Within certain limits, which can usually be ascer-

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[7] P. W. Garret, Government Control over Prices, p. 398.

[8] This is shown in detail by Gustav Schmoller, Grundrisse der Allgemeinen Volkwirthschaftlehre, Pt. 1, pp. 470, 471.

[9] Bulletin No. 341, W. J. Spillman and others on the Farm Management Practice of Chester County, Pa.

[1] Attention is also called to the passages just preceding and following the quotation. They contain concrete illustrations of the views expressed in the quotation.

tained by farm-management survey methods, a farm enterprise may add materially to the profits of the farm business, while if the enterprise be made either smaller or larger than this the profits are reduced. Generally speaking, the farmers in the older settled agricultural sections have arrived at this optimum magnitude for the various enterprises they maintain on their farms. But they have done this in response to the action of obscure economic forces which are not clearly perceived. Hence many of them make mistakes in the matter of relative magnitude of the enterprises they maintain.

Some additional examples, mostly for the law of increasing returns, will now be given. Bulletin No. 651, on Anderson County, S. C., by A. G. Smith:

Crop acres per work animal	11 or less	12–15	16–19	20–23	24–27	28 or more
Per cent on investment	2.64	3.30	3.67	4.32	3.62	2.86

The maximum rate of return is 4.32 per cent on 20–23 acres. This example shows the three laws in absolute purity.

Bulletin No. 659. R. E. Willard on Ellis County, Texas, page 29:

Size of farm	80 acres or less	81 to 120	121 or more
Per cent on investment.......	6.0	6.4	6.4

From same Bulletin No. 659, page 41:

Acreage in cotton	25–63	63–72	72–76	76–82	82–99
Per cent on investment	5.8	5.9	6.1	6.8	6.9

Bulletin No. 694. H. M. Dixon on Lenawee County, Michigan, page 21:

Capital	$7,000 or less	$7,001 to $11,000	$11,001 to $15,000	$15,001 to $20,000	Over $20,000
Average labor income	$276	$386	$488	$569	$1139

Bulletin No. 716. H. W. Hawthorne on Washington County, Ohio:

Investment	$3,817	$4,860	$7,807
Per cent on investment.........	5.4	7.2	9.5

Bulletin No. 848. W. C. Funk on Small Farms near Washington, D. C.:

Capital	$2,747	$6,430	$7,451	$8,636
Rate of return............	1.3	3.0	8.5	14.0

The law of increasing return shows.

Bulletin No. 941. H. M. Dixon and I. M. Purdon on the Ozark Region in Missouri:

Capital	$3,832	$4,631	$7,133	$8,937	$12,602
Rate of return........	0.3	1.4	4.2	6.5	9.7

The above is a combination of the two tables contained in the Bulletin entitled *Rolling and Hilly Farms* and *Valley and Level Upland Farms.* While the two cases undoubtedly differ in regard to the size giving the maximum, the tables themselves do not establish it. The combined table just shows the law of increasing returns.

Bulletin No. 603. E. A. Boyer on Green County, Wisconsin, and Kane County, Illinois, page 13.

There are two interesting tables on dairy farms. The author thinks that Table VIII shows the profit in relation to the kind of dairy products sold. But, rearranging it according to the size of the capital, the law of increasing returns is shown. It is, therefore, possible that his results prove really nothing as to the relative advantage of the kind of dairy products sold. The rearranged table is as follows:

Capital	$22,496	$29,879	$33,609	$37,794	$37,977
Per cent on investment.....	3.3	3.9	4	4.6	4.6
No. of farms investigated...	3	49	32	33	26

Again the next table, Table IX, is supposed to show that frequently the deciding factor in reference to profits on dairy farms is the fact whether the cows are grade or pure bred. Rearranging the table according to size of capital we have:

Kind of Cows	Mixed or other grade	Grade Holstein	Mixed or other grade	Part pure bred Holstein	Grade Holstein	Part pure bred	Pure bred
Capital..............	$20,689	$30,652	$35,301	$38,279	$39,542	$41,318	$42,615
Per cent on investment.	2.8	3.6	4.8	3.7	4.6	5	5.7
No. of farms..........	10	62	22	3	34	9	3

In both tables the columns of three farms should be omitted. This is too small a number for secondary data. If this is done the table just shows the law of increasing returns and does not support the author's conclusion.

Bulletin No. 735. S. B. Nickols and E. L. Currieron, on Sugar Beets in Billings region, Montana, page 36:

Acres	5 or less	6–10	11–15	16–20	21–30	31–40	41–50	51–60	Over 60
Profit per acre..	$0.34	5.78	6.87	8.05	13.19	12.28	13.92	13.39	11.37

This table shows all three laws with only one discrepancy, that from 31 to 40 acres, which probably could have been smoothed out by a smaller grouping.

These examples show that in every industry there is an optimum size, which, however, is not necessarily the same for successive years. The phenomena of increasing and decreasing returns follow from it as a mathematical necessity. But in this respect the examples have shown certain discrepancies which require a further explanation: The most exact, the most advanced of all sciences are astronomy and physics; but even there the primary data are not taken at their face value. They are analyzed, corrected, and some of them, if need be, rejected. A similar investigation is quite possible in the case of economics.[2] If extraordinary conditions surround the operations of a factory, its primary data may be corrected accordingly before they are averaged with the data of other factories. If this had been done in the Reports and the Bulletins the discrepancies would not have appeared.

The optimum size of capital is different in the different industries, because it depends, among other things, on the technical stage of development of that industry. The highest size seems to be in the railroad business, about a billion dollars. A profession is a business in which the optimum size is insignificant. In agriculture it is obviously small, but in dairying and allied industries it may be considerable. The optimum size is of profound importance in every respect, but this cannot be shown here in detail.

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[2] E. g., on page 413 is shown how to adjust the primary data on capital before using them to form the secondary data.

4. Our next task is to ascertain the facts as to the difference in the cost of production of factories engaged in the same industry.

The publications of the Federal Trade Commission show great differences in the costs of production of different producers of the same article. The cost of producing copper in 1918 ranged from less than 12 cents a pound, to more than 26 cents a pound; producing a ton of bituminous coal in the southwest field of Pennsylvania from \$1.16 to \$4.67; raising a twenty-month old steer for the market from \$52.18 to \$77.09; making book paper from less than \$55 a ton to over \$90 a ton. That these large differences actually form the structure of every industry and are not isolated instances appears from the following table,[3] showing in detail the structure of the newsprint paper manufacture in the United States in 1913.

	Number of mills	Produced tons	Per cent of total
Less than \$27	2	169,548	18.0
\$27 and less than \$30	3	82,773	8.7
\$30 and less than \$33	1	75,290	8.0
\$33 and less than \$36	8	214,678	22.7
\$36 and less than \$40	17	361,602	38.3
\$40 and over	2	40,472	4.3

The average cost per pound of producing sole leather in four *efficient* tanneries in 1914 was, in cents, 21.3, 23.6, 28.9, and 32.2; so that the last has a cost of 50 per cent higher than the first.

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[3] Report on the News Print Paper Industry, June 13, 1917, p. 91.

The most interesting data refer to the steel industry.[4] The ranges of the costs of production for the commodities named are as follows: Beehive coke, from $2.93 to $11.45; pig iron (basic), from $18.44 to $45.72; ingots (open hearth), from $30.60 to $66.34; structural shapes, from $45.54 to $76.79; plates-sheared, from $46.30 to $82.25; merchants bars, from $44.82 to $87.15.

The report of the Commissioner of Corporations on the steel industry contains many other illustrations [5] taken from the books of the U. S. Steel Corporation for the year of 1910. The average costs of ore per ton for three Lake districts, consisting of 43 mines, were as follows:

District	Cost	Labor	Supplies
Mesabi range	$1.05	0.21	0.11
Vermilion range	1.45	0.57	0.30
Michigan range	1.89	0.91	0.30

The cost of production differs even in the different mines of the same district. In the first two districts, the costs in the different mines vary from $0.56 to $2.96. In the Michigan district, the costs of production in the different mines vary from $1.39 to $5.64.

The corporation has 21 furnace plants in which it makes Bessemer pig iron. In the 15 furnaces of the Lake district "the cost above material — the most significant figure — ranged from $0.79 per ton to $2.75 per ton." [6] The total costs in the different plants range from $9.00 to $14.00.[7]

In ingots the same differences are shown on the whole, in each item and in each of its thirteen plants. The main differences are here in the pig iron, the raw material cost. But the works cost above material, also show substantial differences, being from $0.93 to $2.40.

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[4] P. W. Garret, Government Control over Prices, published for the War Industries Board, p. 404. The details of the tables are most illuminating, but cannot be given here.

[5] Pt. 3, pp. 182 ff.

[6] Ibid., p. 411.

[7] Ibid., p. 412.

Having established that differences in the costs exist, examples will now be given showing that the costs decrease if the size of the capital (or of the operations) increases.

BESSEMER PIG IRON, STEEL REPORT, PART 3, p. 403.

Tonnage group	Under $150,000	$150,000–300,000	$300,000–450,000	$450,000–600,000	Over $600,000
Average cost above material	$1.75	$1.32	$1.05	$0.99	$0.95

BASIC PIG IRON REPORT, PART 3, p. 413.

Tonnage group	Under $150,000	$150,000–300,000	$300,000–450,000	Over $450,000
Average cost above material....	$1.36	$1.02	$0.98	$0.97

BESSEMER BILLET INGOTS, REPORT, PART 3, p. 426.

Tonnage group	Under $150,000	$150,000–300,000	$300,000–450,000	Over $450,000
Average cost above material	$1.91	$1.53	$1.11	$1.09

IRON ORE, REPORT, PART 3, p. 388.

Tonnage group	Under $500,000	$500,000–1,000,000	$1,000,000–1,500,000	$1,500,000–2,000,000	Over $2,000,000
Average cost.....	$1.36	$0.68	$0.58	$0.65	$0.57

MESABI RANGE UNDERGROUND AND OTHER MINES

Tonnage group (gross tons)	Mines	Av. cost
Under 200,000	7	$1.37
From 200,000 to 400,000	4	1.20
From 400,000 to 600,000	2	1.21
From 600,000 to 800,000	1	1.23
Over 800,000	1	.95

OLD RANGE MINES

Under 200,000	10	2.02
From 200,000 to 400,000	5	1.69
From 400,000 to 600,000	2	1.52
Over 600,000	1	1.79

In view of the small number of mines another grouping would have been preferable, as it would eliminate the small discrepancies.

It is important to know that not only the total cost of production decreases, if the capital increases, but that every constituent part of the cost decreases as appears from the following examples: Defining as large plants in the canned food business, those that pack over 50,000 cases; and as small ones, those of less than 50,000 cases a year, the costs in the large and small ones compare as follows: [8]

Items	1916		1917	
	Large plants	Small plants	Large plants	Small plants
Number of plants	17	52	40	41
Number of cases packed	1,818,387	1,364,303	4,046,639	1,175,874
Cost of raw fish	$1.077	$1.456	$1.494	$2.024
Cost of containers	.803	.865	1.153	1.345
Labor costs	.618	.750	.648	.996
Other expenses	.993	1.040	1.007	1.316
Cost of production, excluding raw fish	2.414	2.655	2.808	3.657
Total cost of production, excluding selling expense	3.491	4.111	4.302	5.681

In the case of factories that produce a variety of grades and sizes of articles, the concept of the operating ratio [9] permits a comparison of the costs of production. This is not done in the Reports, but the profit is sometimes figured as a percentage of the cost. It is obvious that the former increases, if the latter decreases; therefore the following tables may well be quoted: [1]

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[8] Report on Canned Foods, December, 1918, p. 46.

[9] The great importance of the operating for allied problems cannot be shown here.

[1] Report on Shoes and Leather Costs and Prices, June 10, 1921, p. 103. A similar table for tanneries is on page 165.

Sales and Profits of Shoe Manufacturers

Group	Profit on cost of production	
	1918	1919
Over $3,000,000	7.8	13.6
$1,000,001 to 3,000,000	6.4	12.2
$250,001 to $1,000,000	5.3	10.7
$100,001 to $250,000	5.3	8.8
Under $100,001	4.1	6.7

In agriculture the same phenomena holds; not only the total cost, but also each constituent part of it is smaller in the case of a farm with a larger capital. In Bulletin No. 341, Table 27, page 60 shows:

Sizes of farms in acres	Productive work units per farm		Crop acres per man	Man labor per crop acre	Value of labor per month per man	Crop acres per work horse	Work horses per man	Value of machinery per crop acre	Ratio of cost buildings to farm income	
	Man	Horse							Dwelling	Other buildings
13 to 40	184	82	13.7	$20.74	$23.93	9.0	1.5	$15.11	3.41	2.78
41 to 60	299	140	20.2	15.78	26.60	11.9	1.7	12.57	2.19	1.91
61 to 80	372	177	23.2	13.98	27.12	13.9	1.7	11.92	1.88	1.89
81 to 100	475	226	25.2	13.46	28.30	14.5	1.7	10.79	1.76	2.03
101 to 120	551	259	25.6	13.64	29.22	15.0	1.6	11.80	1.83	1.92
121 to 160	582	286	29.0	11.80	28.50	16.8	1.7	9.20	1.62	1.83
160 plus	856	444	31.1	13.05	33.77	17.4	1.8	8.94	1.68	1.91

As a matter of fact no examples should be needed to prove that the costs decrease with the increase in the capital. There is no difficulty in reducing the cost in any factory, if additional capital is made available, by the installation of additional labor-saving machines; because there is no difficulty inventing, if necessary, new labor-saving machines. The difficulty lies only in the fact that the cost of them will reduce the rate of profit on the whole capital, if the saving due to their introduction amounts to a rate on their purchase price, which is smaller than the return on the investment before they were installed;[2] a point which obviously has an important bearing on the emergence of the optimum size.

There is another way of reducing the cost of production, which will be stated, but its consequences will not be further considered. In all that has gone before we have tacitly assumed that we were dealing with a factory. If, however, we considered a plant (that is to say a combination of several factories owned by one party), then there is an important case in which the size of the main factory remains at the optimum size; but its cost of production is materially reduced by the ownership of another factory, which furnishes it the raw material, an ownership which is called vertical integration. Take for instance, two producers of pig iron. Suppose that their blast furnaces are identical in every respect, are located side by side, so that all items of labor and transportation are the same for both. But suppose that producer A buys his ore, while producer B owns ore lands and uses his own ore in the manufacture of his pig iron. It is obvious that the cost of ore for producer A will be greater than that of B, because A pays the *market price* for ore. On the other hand, when producer B figures his cost of production, he will add to his *cost of producing his ore* the cost incurred at the blast furnace.

The actual figure taken from the Steel Report[3] will illustrate the matter:

Cost of producing a ton pig iron by Steel Corporation-B	9.71
Allocated profits on anterior operations	4.18
Cost of production of producer, A, who pays market price of ore ..	13.89

A vertical integration has the purpose of furnishing cheap raw material to the factory and thus it reduces the cost of production. But what the rate of return on the

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[2] The exact formulation of this will be given as part of the theory.

[3] Pt. 3, p. 396.

total capital is in this case will not be investigated here. The great differences in the costs of production in the steel business, shown above, are partly due to such integration. We have one completely integrated plant in the U. S. Steel Corporation. The others buy, wholly or partly, their ore, or their pig iron, or their semi-finished product, so that there are no two plants that are integrated just to the same degree. The two main causes for differences in cost are, therefore, differences in size, in the case of factories; and this together with integrations, in the case of plants. But as the degree of integration, like that of size, shows itself in the size of the capital, we are justified in saying that the cost of production depends on the capital employed, in a manner, however, which is quite complex, if the vertical integration is also taken in consideration.

In conclusion, it will be shown presently that the investment in the tools of production, per unit of product, is the smaller, the greater the capital is. The above table from Bulletin No. 341 contains also some examples.

5. What causes bring about the emergence of the optimum size? The large-scale producer has very little advantage in securing his raw materials because most of them are either traded on exchanges or have such a well-known market price as to put him on a parity with the small-scale producer. He has very little, if any advantage on the marketing side, because the small-scale producer need not depend so much on others, nor on costly statistics and records. The source of the law is found on the producing side. The cost of production decreases, but at the same time an opposing force is set in motion and the result of both is the emergence of the optimum size.

Man's unaided capacity for labor is very small and limited in a great many respects. For instance, he can neither lift a great number of pounds, nor can he lift it to a great height. In order to increase his capacity, man employs tools. A rope and a pulley enable him to vastly increase the load and the height of the lift. A relation exists between the cost of a tool, its size and the increase in capacity which it makes possible: It is as follows: *The larger the size of a tool, the smaller is its cost per unit of capacity.*

Take for instance, the casks and tubs used so extensively in many lines of business. The capacity of a tub to hold a fluid is proportionate to its volume, but its cost depends on the amount of lumber it contains and is, therefore, proportionate to its surface. A barrel of twice the capacity does not contain twice the amount of lumber (or twice the surface) but only about 40 per cent more, so that an increase in price of 40 per cent purchases an increase in capacity of 100 per cent. Consequently, a cubic foot of capacity costs less the larger the barrel is.

Exactly the same applies to a great many other tools, or fixed commodities, like warehouses, freight cars, steam boilers, and engines. In all these cases the result emerges from the fact that the capacity of this group of tools depends on one property (on the volume) while the cost depends upon another property of the tool (on the surface) and that, according to a theorem of solid geometry, the volume of a body grows faster than the surface if the linear dimensions are increased.

In the case of other fixed commodities, two other physical properties give rise to the phenomena. For instance, the capacity of iron bars to resist pressure or to carry weight depends on one of its properties, its resistance or elasticity. The cost depends on another property, roughly, on the weight. But physicists show that their elasticity increases much faster than the weight, and, therefore, the carrying capacity per pound costs the less the larger the size of the bar.

In general, it will be found that the property of a fixed commodity in virtue of which it increases man's capacity for the work is not the same as the one determining its cost and that the former increases much faster than the latter if the size of the tool increases.

Other, but similar relations show in the case of the steam engine. The cylinder walls are a source of loss of heat to an enormous extent. But the cylinder walls, the surface of the cylinder, increase slower than the volume, or the capacity of the engine. Therefore, the loss due to it is comparatively smaller in a large, than a small engine. The consumption of coal per horse power per hour is three pounds or even more in small, two pounds in large, and only about one pound in the enormous marine engines. In most manufactures the expense for coal constitutes from 10 to 20 per cent of the total cost of production and the tremendous advantage of the larger tool, the larger engine, would in itself prove the existence of one of the two opposing forces.

A similar result is seen in the dynamo electric machine. This is a machine which transforms mechanical energy into electric energy. The transformation is accompanied by loss of energy due to a great variety of causes. Among others a part of the mechanical energy is converted into heat in the armature and the electromagnet, a part is lost in friction in the brushes and the bearings, and a part sets up electric currents in the machine which cannot be utilized. All these losses can be figured and the formulae based on the laws of electricity and mechanical energy clearly show the relative advantage of larger machines.

The tools of railroads consist of rails, cars, and engines. The saving due to larger engines has already been noticed. Heavier rails decrease materially the cost of maintenance, larger cars can be handled more economically than smaller ones. A larger mileage is operated more cheaply than a smaller one, as the general expenses per mile decrease.

So much for the force which is the source of the law of increasing return. Now we must investigate the force which opposes it and ultimately overcomes it so that as the result of both the law of the maximum rate of return, and ultimately that of the decreasing return, emerges.

Every tool has a property in virtue of which it increases man's capacity to labor, as shown above. But it has many other properties, and one or some of them set up disadvantages wholly disconnected with the capacity under investigation. For instance, a lever increases man's capacity to lift weights, and the more disproportionate the two arms are, the greater is the increase in the capacity. There is no limit to this. When Archimedes said he could lift the earth from its hinges if only he were given a fulcrum for a huge lever, he was right, theoretically. But practically he was quite wrong. Unfortunately a lever has weight itself. This is disregarded in the law of the lever in physics, but cannot be disregarded in economics. The longer the lever, the heavier it gets, and at last a length is reached beyond which it becomes unmanageable to man. A similar condition exists with rope and pulleys, where at last the friction counteracts all theoretical advantages. And the same holds good in the most complex factory. The occasional stoppages of a factory with huge machines, are much more costly than those in two factories with smaller machines. Moreover, there are innumerable such forces that no one can foresee, and which only experience brings to light. The American Tobacco Company was very successful in large-scale production of cigarettes and chewing tobacco, but when it applied it to that of Havana cigars, it was a total failure for causes which nobody could foresee, and the plants had to be disintegrated into their original units.

The many attempts at large-scale production in the straw board manufacture proved failures. The largest electric city lighting plant cannot always underbid the small plant of an office building, because the exhaust steam can be used for heating purposes there. In regard to railroads, the late Mr. E. H. Harriman has given the following explanation:[4]

> Did you ever ride in the cab of one of the modern freight locomotives? Well, you probably noticed the swaying back and forth that accompanied the drive of the pistons. That meant that the centre of gravity had crept up just about as high as it could go without having the engine topple over when it got into action. It told you that we had gone as far as we could in building engines up into the air. Now, if you will think a minute you will see that there is obviously a limit in length of fire-box beyond which it is impossible to fire an engine. And we have reached that limit as well. So there you are. If we increase our car capacity we increase the unproductive dead weight that is to be drawn disproportionately to the increase of the load, and in so doing we are making demands upon tractive power that has already reached the limit of its development.

In downtown office buildings, the number of elevators increases with the height of the building. But they cause a waste in the rentable space. For this and other reasons there is a certain height of an office building which gives the maximum rate of return. In St. Louis it is believed that a twelve-story steel, or an eight-story reinforced concrete building gives the best results. In transportation, the length of the railroad depends largely as to how far bulk need not be broken; therefore, the roads still extend only from the Atlantic coast to the Mississippi river, because as yet there is not enough through traffic for a single road from coast to coast.

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[4] The Financial Chronicle, March 23, 1907, p. 660.

In blast furnaces[5] large size has many advantages: economy of installation, of labor, and administration per unit of product, and the fact that the proportion of the heat-wasting surface increases much slower than the contents, due again to above geometrical law. But here, too, other properties, disadvantages, exist that grow apace, faster at last than the advantages, so that a limit is reached. The width at the bottom is now generally 12½ feet, and the most economical height is considered to be 80 feet. These results have only partly been ascertained by an investigation of those many countervailing problems, they are largely the result of experience.

In agriculture it is easily seen that there is an amount of labor that will yield the maximum. The purpose of plowing the land, and even of most of the fertilizers, is to put the surface of the land in the proper *physical* condition so as to permit the free passage of water and air. If the soil is not broken up at all, neither water, nor air can freely enter. If so much labor is expended as to break up the soil into such small particles as to permit it to coalesce on its own accord, the impenetrable surface restores itself. Between these two extremes, both yielding zero, as it were, there is an amount of capital and labor that will put the soil in just the best shape to permit the free passage of water and air, and that amount of labor will yield the maximum return.

There are a great many additional causes for the emergence of the law. With the increase in the size, labor per acre is less, less horses are needed, less machinery, altogether a smaller capital per acre, less for building, less for fences. But the countervailing influence also grows with the distance of the farmhouse from the different parcels of land, as Schmoller[6] has already pointed out.

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[5] Encyclopedia Britannica, art. Iron and Steel. In the Steel report, Pt. 3, p. 80, a similar view is stated.

[6] Loc. cit. See also G. F. Warren, Farm Management, pp. 264, 265, and particularly chap. VII, where a wealth of data on the optimum size all over the United

But even here, as in industry, the scientific study of this problem has not succeeded in illuminating all obscure points, and we are still largely guided by experience. Agriculture, being an old industry and being practiced by millions, has naturally an enormous fund of experience, and every district may well be relied on to know the optimum size. For instance, as regards the farms in the Ozarks, the following statement is made:[7]

> The operation of a general farm with much less than forty acres of land for crops is exceedingly unsatisfactory, regardless of the location of the farm, whether among the valleys or among the hills. Size of business is an important factor in farming throughout this area, but it is also true that the limit to the number of acres of crops which can be profitably included in one farm by the average operator is reached more quickly with farms of rough and stony character than in the case of farms with land more easily cultivated, and perhaps this limit has been reached by some of the larger hill farms.

II. THE THEORY

1. At the outset we must adapt the present laws of diminishing and increasing returns for our purposes. The customary way of showing their emergence is as follows:

Take *one* and the same piece of land and employ on it two or more ever-increasing amounts of capital in *two* or more successive years. The successive crops will exhibit the laws of increasing or decreasing returns as the case may be. In this manner of treatment only the physical quantities of the successive crops can be compared because as Marshall puts it:[8] "It is important to remember that the return to capital and labor, of which the law speaks, is measured by the amount of the produce

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States is to be found. On the influence of distance in the case of cattle production, see Bulletin No. 588, J. T. Tardine, pp. 10, 11.

[7] Bulletin No. 941, H. M. Dixon and I. M. Purdon, p. 14.

[8] Marshall, Principles, p. 229.

raised, independently of any changes that may *meanwhile* take place in the price of produce." For instance, if the returns are 25 bushels the first year, and 20 bushels the next, they would exhibit a law of diminishing returns. But if the prices per bushel are $1.00 and $1.50 respectively, so that the values of the crops become $25 and $30 respectively, the values would vitiate the emergence of the law in that they would show in this case an increasing return; and if several years are taken the values would show ordinarily no law of any kind. If we lived in a world in which prices did not change, but remained always the same, the values would exhibit identically the same laws as the physical quantities; because the proportions between the figures of a series do not change, if each figure is multiplied by the same amount. If, for instance, the successive crops are 25, 20, 16, 13, 11, and the unchanging price is $2, the series of the values would be $50, $40, $32, $26, and $22; and would exhibit the same law of diminishing returns as the series of crops measured in bushels.

The disadvantage of this customary method of showing the emergence in physical quantities lies in this: Our account books show values in money, and not physical quantities in bushels. Therefore, there are neither experiences nor experiments available to prove these laws, and the text books contain only schematic figures.

There is, however, a second manner of showing the emergence which obviates this serious drawback.

Take *two* or more pieces of land of identical quantity and quality — which can easily be done by dividing one piece into two or more equal parts — and employ on it in *one* and the same crop year, two or more increasing amounts of capitals. The price per bushel of the crops on the various plots will of course be the same, there is no "meanwhile" here at all, so far as these various crops are concerned; a bushel of the crop on the first plot is worth identically the same as a bushel of the crop on the second, or third, or any other plot; neither the inequality of the seasons, nor any other change will differentiate one plot from another; in brief, the time element as the cause of change is entirely eliminated. The only thing that differentiates one plot from another is the difference in the capitals employed on them. Any law that is exhibited by the quantities, will also be exhibited by the values of the crops.

Moreover, an additional concept will be introduced. The customary schematic illustration of the laws of returns is best shown in a table of three columns. The first contains the increasing series of capitals, the second the produce, the third the differences of the figures contained in the second column and which are assigned and allotted to the differences in the figures of the first column, to the successive "doses" of capital. Here we shall add a fourth column. It will contain in each line the produce per unit of capital, or rather per hundred dollars of capital; in other words the *rates* of return, the rates of profit, realized on these various capitals. In their nature each figure in the fourth column is a ratio of the two figures on the same line in the second and first columns respectively, expressed in per cent. This fourth column is so important for our purposes that we have frequently omitted the second and third columns and just show the comparison of the capitals and the respective rates of profit realized on them.[9]

Economists have constructed another pair of laws of returns based on tendency, on time. A law of decreasing returns is supposed to hold in time for agriculture, and one of increasing returns for industries. The results obtained are wrong, or as Marshall expresses it "unsatisfactory."[1] He also suspects the source of the error, namely, that the concept of a supply curve in *time* has three, and not two dimensions, and those theorems based on a descending supply curve are obviously invalid.

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[9] Marshall, Principles, p. 231 n. gives an experiment on four plots. Carver, Distribution of Wealth, p. 58, Table A, omits col. 3 and shows col. 4. Taussig, Principles, vol. ii, pp. 57–59, treats the problem of rents in both manners, but none recognized that in the second manner of treatment the values instead of physical quantities may be taken, and thus the financial statements of businesses be used in support of the theories.

2. It has been shown that larger capitals permit a smaller investment per unit of production for every constituent part of the capital, if the tools are of *larger* size. Nothing has been said what the result would be, if the larger capital is used, not for larger tools, but for a greater number of tools of the same size. What would be the result, e. g., if a factory of $200,000 just duplicates the appliances of a factory with a capital of $100,000; in other words, if the larger capital consists in more, but not in larger tools than that possessed by the smaller capital.

Two engines of one horse power each can do pieces of work which one engine of one horse power cannot do, and similarly with two laborers. A factory with twice the working capital can accept orders which the smaller one must refuse. If the times are dull, this is indeed an advantage. But here we suppose normal times, that is to say a condition in which the business offered equals the capacity of the factories. Therefore, there is no advantage in this feature at all.

If, however, we define a larger capital to mean larger tools, then the examples show that not only is the investment per unit of output smaller in the case of larger capitals, but that the cost of production of larger tools, of larger capitals is smaller. Under the term larger capital, we shall mean one consisting of larger tools and not one of more tools of the size of the smaller capital.

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[1] Marshall, Principles, p. 519, and note p. 520.

For capitals thus defined the following law of increasing rate of returns holds for every constituent part of the capital:

In every production, each of the constituent parts of the capital exhibits a law of increasing returns, in that its successive doses earn an increasing rate of profit.

The interaction of the different constituent parts of the capital forms a barrier which brings this increase in the rate of profit to a dead stop at a certain point. Take again the case of working capital, particularly raw material. There is an interaction between it and the fixed assets. The latter can work up into finished products only a certain, clearly determinable, amount of raw material. If there is more of the latter then this amount of the capital invested in it is "dead," it gives no return at all. Up to that point the successive doses of the capital invested in raw material exhibit the law of increasing returns. Every further dose shows no return whatsoever, and similarly with all other constituent parts of the capital. Therefore, the manufacturer will be careful to invest his capital so that not a single dose of any of the constituent parts of his capital shall be "dead." If his doses are $100 each he will in making the plans for his factory gradually allot it to that constituent part which in virtue of the increasing return yields the highest rate and is not yet checked by its relation to the other parts. If he has done this planning well, the completed factory will exhibit such an interaction of the constituent parts of the capitals as to result in the following law:

In a properly arranged business the rates of profit on the marginal doses of all the constituent parts of the capital are equal, and this gives the maximum rate of profit on the whole capital.

This is obvious. If a marginal dose would give a higher rate, if taken from one and invested in another constituent part, this of course would be done. The business man desires to make the maximum rate of profit on his capital and the above arrangement gives him a higher rate than any other.

The above law of production that there is an arrangement of the constituent parts of a capital which gives the maximum rate and that this stage is characterized by the equality of the rates on the marginal doses of the constituent parts, is a counterpart of Gossen's celebrated law which holds in consumption.

G. F. Warren [2] gives a happy illustration of the emergence of the law. He pictures a bucket that has staves of different lengths, each stave represents the marginal rate of a capital item. The profit is presented by the water the bucket contains. Of course the volume of the water it can hold, the profit it can yield, is determined by the shortest stave. The additional lengths of the other staves contribute nothing to the volume of water, to profit. The maximum return is reached if the marginal rates, the staves, are equal. The above law is one of the many cases of parallelism existing between the phenomena of production and those of consumption, but they cannot be given here.

In view of this interrelation it is clear that if one component part of the capital is known, or assumed, every other component part is determined. If, e. g., the size of the factory's engine is known, the size of the building, the amount of the working capital and every other component part is determined if the factory is to be subject to the law of equilibrium.

In the last twenty years the recognition that some balance exists between the constituent parts of a capital has gradually evolved, particularly in the writings of

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[2] Farm Management, p. 171.

T. N. Carver,[3] but the parallelism with Gossen's law has not been noted, nor its exact formulation.

If, then, we compare with each other the returns on equal capitals engaged in the same business we shall find great differences. Those whose constituent parts conform to the above law will yield the maximum rate of profit. The rate will be the less the more the parts deviate from above equilibrium. Two capitals in the same business, both of which are invested in items in equilibrium, will yield the same rate. If all parts except one are in equilibrium and that one increases toward the equilibrium and beyond, the rate of profit on the whole capital will increase till the equilibrium is reached and decrease thereafter.[4] This is most frequently seen in the case of working capital. In a new country farmers have very rarely a sufficient amount of it, or what comes to the same thing, the amount invested in land is too large as compared with the balance, the working assets. The same holds in old countries particularly where a metayer system prevails. The temptation of the tenant to lease too much land for his capital seems irresistible. The optimism of the business man does not, and cannot prevent the proper investment in fixed commodities, but it frequently induces him to attempt business with insufficient working capital; and this results in returns of less than zero, in other words, losses. Insufficient working capital is the main cause of manufacturing, commercial, financial, and agricultural failures. Many violate the law in the beginning, particularly in farming. In industries the start is usually in accordance with the law of equilibrium with a sufficient amount of working assets. But, "by an optimism due to rising prices and the hope of great profits through increased production," the working capital is gradually converted into fixed assets and the deficiency borrowed from the banks, and this is, if done on a large scale, the first step towards a condition of crisis,[5] because if the loan has to be paid when prices are deflated, the deficiency of working capital becomes obvious and the business goes on the rocks.

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[3] See also Arthur S. Dewing, "The Law of Balanced Returns," American Economics Review, 1917, pp. 755 ff.

[4] This phenomenon has been magnified into the original and principal source of the laws of increasing and decreasing return. Marshall, Principles, p. 230.

It may not be out of place to call attention again to the fact that the laws of return used here refer to the fourth and the second, but not to the third column of our schematic representation. The second column shows that the returns *increase*, the third column shows that while they increase, the increase is getting gradually smaller. Here this phenomenon, based on the second column, is called a law of *increasing* returns. In the present economics literature the phenomenon, based on the third column, is called a law of *decreasing* returns. In the terms of mathematics, our description refers to the ordinates of the function, or to their ratio to col. 1, which are given in col. 4, and they increase indeed; the present customary formulation refers to the differences of successive ordinates, and these differences become indeed smaller, the nearer we come to the maximum. The new form is simpler, and as the results show, more fruitful. Finally: Both formulations are directly the results of the existence of a maximum.

In general, a factory that has grown piecemeal is of necessity poorly balanced. This is well known to business men.

The task of building a factory with a certain capital so that the proper equilibrium may exist between the constituent parts is not a simple one. The number of items is so great that the task seems almost equivalent to solving a set of difficult equations with several hundred unknown quantities. Besides, some of the forces that enter into the problem are obscure. Therefore, a strictly balanced plant does not exist.[6]

The theories advanced here hold not only for the business of industries, but also in every particular for the *business* of farming. E. g., in Bulletin No. 757[7] there is a clear statement of the loss due to the increase of a component part of the capital beyond the equilibrium. In Bulletin No. 726 [8] is an excellent statement of the difficulty of ascertaining just when the equilibrium is reached.

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[5] A. Wall in a study of credit criterions, Federal Reserve Bulletin, March 1, 1919, p. 231. This is really self-evident. All gains, all losses impinge upon the current assets.

[6] The same difficulty is encountered by every individual who necessarily tries to arrange his consumption according to Gossen's law. This difficulty is of great importance to the theory of consumption. I believe it explains the emergence of standards of life and also that of ethics.

[7] Hennis and Willard on Grain Farming in North Dakota, p. 10.

3. In what follows only balanced factories will be compared with each other.

It was shown that each constituent part of the capital obeys a law of increasing returns. If then the capital of a factory is larger than that of another, this series of increasing figures is carried further in each of the component parts, in that the whole of the larger capital will yield a larger return not only absolutely, but also relatively, than the smaller one. In other words the rates of return on the invested capitals of different plants engaged in the same industry are the greater the larger the capitals are.[9] This is the old law of increasing returns expressed in a more convenient form.

In the first part a variety of causes was given to account for the fact that the law of increasing returns comes to a stop at the optimum size. As these causes were not known before two other views gained prominence. One was enunciated by Karl Marx. He teaches that the greater the capital the higher the rate of return, the greater the advantage the possessor of the largest plant in any line of industry, so that the smaller plants find it increasingly difficult to maintain themselves, and ultimately a monopoly emerges in every line of industry. Competition disappears. But monopolies are "incompatible with their capitalistic integument" and then "the knell of capitalist private property sounds." [1]

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[8] Moorhouse and others on Sugar Beets in Colorado.

[9] Even this obvious conclusion from the present law of increasing returns overturns the present theories of profit, which are based on the assumption of a normal, an average rate.

[1] Karl Marx, Capital, English edition of Kerr & Co., vol. i, chap. 32, p. 835. He assigns, however, a different cause for the law of increasing returns.

Thus collectivism will not come suddenly, but as the inevitable result of the limitless law of increasing rates of return.

Another opinion advanced was this: There is no limit to the law so far as the "marketing" side of business is concerned. There is also no limit to the "productive" side, but beyond a certain amount of capital any further increase gives only little further increase in the rate of return. This is the view of A. Marshall.[2] It differs from the Marxian theory only in degree and not in kind. If it were true, collectivism would emerge just as inevitably, but the evolution would take somewhat more time.

The view established here is that in consequence of forces that were described in Part I, there is a limit, and that in virtue of the interaction of those forces with those mentioned before a law of the maximum rate of return, or a law of the optimum emerges, which may be stated as follows:

At every stage of development of any industry the law of increasing rate of returns holds up to a certain size of the capital, which yields the maximum rate for that industry. Beyond that size a law of diminishing rates of returns holds.

It is really only necessary to prove the law of optimum because mathematics teaches, and the customary geometric representation illustrates that every optimum is preceded by a law of increasing and followed by a law of decreasing returns. It is important, however, to note that these laws of return are those of column 4 of our schematic illustration.

The theory of the emergence of profit is, then, as follows:

Profit emerges out of differences in capitals, due to the

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[2] A. Marshall, Industry and Trade, p. 249. It is inconceivable how from this view he can deduce, as he does, the survival of small businesses.

law of increasing returns, which in turn is based on the superiority of larger over smaller tools, as to capitalization per unit of output, and as to cost of production.

The emergence of profit is not due to capital as such, nor to its productivity, however defined, nor to abstinence, nor to waiting, nor to a preference of present over future goods, nor to great managerial ability, nor to the labor of the manager, nor to that of his workmen, nor to the exploitation of the latter, nor to the institution of private property. This appears from the following three facts:

1. If all the factories in an industry have the same size of capital, none of them make any profit except they form a trust, which is excluded here.[3]
2. If the factories have different sizes, the marginal producers, the producers with the smallest capital, make no profit.

In these two cases all those concepts are, or may be, present; nevertheless, profit does not emerge.

3. In the larger factories of the second case they are, or may be, present at the same rate, nevertheless the rates of profit differ.

There is no normal rate of profit as the older theories assume. Their primary data are correct, the rates differ. But they ascribed the whole of the differences to fortuitous causes and formed a secondary datum by "adjusting" to an equality the primary data, and thus even the differences which were not due to fortuitous causes were extinguished. But it must be stated that economists have already expressed doubts as to the propriety of this procedure.[4]

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[3] See note on the mathematical theory of competition in the present writer's "Suggestions on the Theory of Value," Quarterly Journal of Economics, August, 1905, p. 583.

[4] Taussig, Principles, vol. ii, p. 123. Differences in the cost of production were always known to exist in agriculture. Therefore it is natural that the first attempt to base on them a theory of profit should have emanated there, namely Ricardo's theory of rent. For its short-comings as well as its connection with the present investigation, see p. 124, ibid.

Karl Marx finds the source of profit in the exploitation of labor. His primary data are quite correct — the labor costs differ, but the manner in which he forms from them the secondary data [5] requires the most careful attention because naturally with its validity stands or falls his whole theory. He first gets rid of the influence of fortuitous circumstances, like occasional idleness or lack of skill. This is quite in accordance with the procedure followed by the exact sciences. Then he notes that there still remain considerable differences in costs. For instance, he points out that the cost of a hand loom weaver is probably twice as great as that of a power loom weaver. We have stopped here and taken these differing costs as our secondary data in the industry of weaving. But Karl Marx does not do that. He says that these differences do exist, but that they are "socially" unnecessary. He thus gets rid of the costs of the small-scale producer and forms his secondary data by averaging the costs of the large-scale producer. His secondary datum for an industry is, then, that there is only one cost, the socially necessary one, as he calls it. But, of course, the label has nothing to do with the contents of the case.

The secondary datum as formed by Marx and used as the basis of his theory extinguishes the most significant feature, namely, that the costs differ. Of course, if we *suppose* that all factories of any industry have the same costs, then profit will indeed not emerge except the factories form a trust and exploit labor as well as the whole public. But this is clear from the beginning, being a direct result of his secondary datum, and there is no further need for thousands of pages to prove it, particularly as it has been known before him. These secondary data describe a condition of society which does not exist under private ownership. It is conceivable, but highly improbable that communism will have nothing but factories of the optimum size in all industries,[6] in which case the costs of all factories will be equal. Therefore, the Marxican theory does not *prove* that we are headed toward communism. It simply *assumes* in its secondary data that a state of communism exists or rather one that may be conceived to exist in communism.[7]

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[5] Karl Marx, Capital, Kerr edition, vol. i, pp. 45, 46.

4. In a credit operation the relation between borrower and lender is that of a partnership in which one partner, the lender, enjoys certain preferences. They are of a great variety and need not be given here. The lender's share of the profits is called interest.

If a manufacturer goes into business by borrowing just as much as he owns himself, his profit, in virtue of the law of increasing returns, will be more than twice as much as he would have realized on his own money alone. He can, therefore, pay the lender one-half of the profits and still be the gainer. On the other hand, the lender receives also more than he would, if he were to go into business with his money. For instance, if the borrower and the lender went into the manufacture of shoes in 1914, each for himself would have realized 13 per cent. By lending the money to the borrower, and staying out of business, the latter would have made 17 per cent on his money, and would have been able to pay the lender also 17 per cent, so that each would have profited to the extent of 4 per cent. But the lender is not entitled to 17 per cent. He can only expect to receive what he would have made, if he had gone into business himself, namely, 13 per cent. Then the borrower would have made 21 per cent, a gain of 8 per cent. But the lender's $100,000 enjoys some preference over the $100,000 of the borrower, therefore he will be satisfied with less. The exact rate will depend on the nature and extent of the preferences accorded him by the borrower. If the lender is satisfied, e. g., with 7 per cent, the borrower makes 27 per cent, while without the loan he would have realized only 13 per cent. Here is a net gain of 14 per cent, or to put it more expressively, the borrower in virtue of the loan makes more than twice as much as without it, and he makes almost four times as much as the lender.[8]

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[6] In agriculture this is quite impossible.

[7] Altogether this is a fine example for Secrist's complaint (loc. cit.): "It is secondary data which are generally used and unfortunately too often without a clear idea as to their merits for the purposes in mind."

Interest is the lender's share of the profit, and therefore it cannot emerge from any other source than profit, namely, from the law of increasing returns. The concepts which do not account for the emergence of profit, and which were enumerated above, do not, cannot account for the emergence of interest. More particularly: It is not due to the labor of the manager or of his workmen. The loan enables him to buy larger machines, he does not buy more machines than without the loan. Moreover his labor is measured, not by foot pounds, or any other mechanical means, but by time. With or without the loan he devotes in the example the same number of hours every day to the business of manufacturing shoes. He loses nothing, the increased profit is a pure gain to him. It is also a pure gain to the lender because he is not in business at all. This seems to be in the nature of a miracle, but economics is full of such miracles, as for instance, in the operation of buying and selling, where also both sides gain and nobody loses anything.

If a business man with a capital of $100,000 borrows $100,000, so that there is $200,000 employed in his business, and if he can properly manage this business on $200,000 capital, then it is clear that his managerial capacity is larger than the one needed for a capital of $100,000. Managerial talent is a constituent part of business, but, of course, not of the capital. Nevertheless, the law of equilibrium which holds for the constituent parts of capital may be applied also to managerial talent. And here deficiencies and excesses occur frequently, and it cannot be otherwise under the institution of private property. The manager or owner may be, and frequently is too big or too small for his job. In the above case the manager is too big, or the capital of $100,000 is too small for the equilibrium. The only way to establish a better equilibrium is to borrow the other $100,000, and thus the law of increasing returns is put into motion and yields the pure gain to borrower as well as lender. The lender gives no labor for it, he loses nothing, or to use Warren's illustration, his labor, time, and talent staves have the same length before and after the loan. By increasing it till it equals the former, the bucket, the business, "holds" more profit, although none of the three staves have been increased in length.

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[8] This is even *after* allowing himself wages.

The size of a loan may be measured in two ways. First, it has an absolute size, in dollars. A large loan, measured thus, can easily be broken up into small ones, and small amounts can be combined into a large loan. These operations need the assistance of a banker, but his charges are part of the expense of raising capital and not a part of the interest payments. The size measured in this way, has, therefore, no influence on the rate from the point of view discussed here, but it is, indeed, influenced by the former in virtue of the laws of price. The second manner of measuring the size of a loan is relative by comparing it with the amount of money owned by the borrower. In other words, the loan is measured as a proportion of the borrower's net assets, and in the case of commercial loans, as a proportion of the borrower's net current assets. The lender is really not interested in the kind of business to which he makes the loan, except as it has a bearing on the safety of the loan. The latter feature has a profound influence on the rate and the smaller proportion the loan is of the borrower's assets the less is the rate. Taking loans of the same relative size the following theorems follow from the differences in safety:

There is no normal rate for loans, just as there is none for profits. A loan to the business of the optimum size yields the minimum rate of interest. The rates on loans to other sizes of business move in the reverse order to that of the rate of profit. They will show a law of decreasing returns where profits show a law of increasing returns and vice versa. The (minimum) rates of the optimum sizes of different lines of business decrease with the increase in the optimum size because their rates of profit increase.

The element of time also has an influence on the rate of interest because time may change the factor of safety. Ordinarily, the rate is the higher the longer the loan runs, as e. g., in the case of farm and building loans. If the safety is not thought to suffer in time, as in the case of nations, and even of public service corporations, like railroads, the rate will be the same, irrespective of the length of the time; as witness the British Consols, the French Rentes, or the 100-year mortgage bonds of some of our trunk line railroads.[9]

The most important effect of time is seen in the difference of rates between commercial loans and "long time" loans. The former is defined as a loan for a season or a shorter time. A commercial loan for the peak of the season commands the lowest rate, one for the whole season the highest rate, but it is ordinarily lower than long-time loans. The peculiar characteristic of the commercial loan is due to the fact that the lender is satisfied with a remuneration which does not equal the agreed-upon rate of the loan for a year, or a season, but only that ratio of it which the length of the loan bears to a year. If, for instance, the loan is for a month, the lender receives only one-twelfth of a year's interest. But every dollar in business realizes the same profit, actual profit (and not pro rata profit), whether it "works" the whole season or only a day.[1] Such loans obviously yield, comparatively speaking, enormous profits to the borrower. For instance, on a 4 per cent loan, that runs only for a single day of the year, the borrower makes more than a thousand times as much as the lender, hence the profound importance of commercial loans for business and the whole economic life of a people.

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[9] In recent years the borrowing states as well as the lending citizen seem averse to loans running a very long time. The western municipalities frequently make loans for only a limited number of years, and even serially as if they shared the view of Thomas Jefferson, that no loan should be permitted to run longer than the life of a generation, which in Jefferson's time was 21 years.

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[1] This is obvious from the definition of capital given, particularly if the Federal Trade Commission had used the highest amount of commercial loans in force during the year instead of the average. Only then can a factory that uses commercial loans be compared with one that does not, or not to the same extent. If this had been done, some of the deviations from our laws would not have appeared in the examples at all. This shows again that the formation of secondary data requires the utmost care and caution.

The phenomena mentioned above show that the element of time enters the problem of profit and interest, but that it is not, and cannot be the cause of their emergence as some of the older interest theories have it. Profit, and consequently interest, are concepts of two dimensions, size and time. This is obvious from the very first line of every profit statement which gives the sales "during the fiscal year." The selection of the year as the unit of time is due to most important economic considerations, and is not purely a matter of practical convenience as Bohm-Bawerk thought. See the present writer's, " Einige Betrachtungen über Bohm-Bawerk's Positive Theory des Kapitals," Jahrbücher für Nationalökonomie und Statistik, July, 1911, p. 88.